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New record of the Jaguar, *Panthera onca* (Linnaeus, 1758) (Felidae), from a mosaic of Atlantic Forest in the Paraná state, Brazil

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Abstract: The largest felid in the Americas, the Jaguar (*Panthera onca)* has had its geographical distribution reduced to approximately half the original range throughout the years, and most of its remaining distribution is in Brazilian territory. Deforestation is considered the main threat to the species, especially in the Atlantic Rainforest, which is currently highly fragmented and modified. This article provides a new record of Jaguar in Paraná state, in an area occupied by a mosaic formed by native vegetation and silviculture, and represents a new recent locality of the species for the biome in which it is classified as Critically Endangered of extinction.

Key words: Carnivora; Monte Alegre Farm; silvicultural landscape; Telêmaco Borba

Considered the largest felid species in the Americas, the Jaguar, *Panthera onca* (Linnaeus, 1758), is the only species of the genus found in the New World (Macdonald et al. 2010; Martins 2015). Originally, this species range extended from northern Argentina to North America, covering a large portion of southern United States (Sanderson et al. 2002; Zeller 2007). Currently, its range is only half of the original, and approximately 50% of this current range is within Brazil (Zeller 2007). Additionally, this species is locally extinct in several countries, such as Uruguay and El Salvador (Caso et al. 2008).

The main threats for this species are anthropic modification of landscapes (Ripple et al. 2014), resulting in habitat loss and fragmentation (Morato et al. 2013; Villard & Metzger 2014), reduction in prey abundance (Ryall & Fahrig 2006; Ahumada et al. 2011), and increase of hunting (White & Lowe 2008; Inskip & Zimmermann 2009), motivated mainly by conflicts generated by predation of livestock (Caso et al. 2008; Palmeira et al. 2008; Paviolo et al. 2008).

The Jaguar is extant in all Brazilian biomes, with the exception of the Pampa (Torres et al. 2008; Nascimento & Campos 2011), and its presence and abundance depend on factors such as prey availability, presence of water bodies, and well-preserved native vegetation (Eisenberg & Redford 1999; Sunquist & Sunquist 2002; Arroyo-Arce et al. 2014). In the Brazilian Atlantic rainforest, where fragmentation and modification of the landscape have been intense, it is estimated that in the past 15 years the population of this felid has been reduced by at least 80% (Morato et al. 2013). Currently, it is believed that the species is divided into eight subpopulations within the Atlantic Rainforest (Beisiegel et al. 2012) and the total population size does not exceed 300 individuals (Paviolo et al. 2016).

Considered as one of Earth's 34 biodiversity hotspots (Myers et al. 2000; Mittermeier et al. 2004), the Atlantic Rainforest historically extended north to south along the Brazilian coast, inland reaching as far as Argentina and Paraguay, and covering an area of 1,315,460 km^2 (IBGE 2008). Deforestation represents the main threat for this biome, which is currently reduced to approximately 12% of its original size (Ribeiro et al. 2009). This drastic reduction in the available habitat, associated with constant threats to the survival of the species, account for the categorization of the Jaguar as Critically Endangered in this biome (Beisiegel et al. 2012; Paviolo et al 2016).

In Paraná state, southern Brazil, the range of the Jaguar is divided in three regions, as follows: 1) Foz do Iguaçu Region (Green Corridor), on the border between Brazil and Misiones, Argentina; 2) Extreme Northwest, between the states of São Paulo, Paraná, and Mato Grosso do Sul; 3) Serra do Mar / South, in the Serra do Mar range (between the states of São Paulo and Paraná) and municipalities in the southern part of Paraná state (Lima et al. 2013). The Jaguar subpopulation of Paraná is one of six along the Brazilian Atlantic coast (Haag et al 2010; Beisiegel et al. 2012).

The pelt of this species is yellowish, with dark rosetted spots, and differently from other Neotropical felids, the

Figure 1. Captures of the camera trap filming of the Jaguar, *Panthera onca*, on Monte Alegre Farm, Telêmaco Borba, Paraná state, in 2016.

rosettes are larger, fewer, and often having one or more black dots inside (Kitchener 1991; Sunquist & Sunquist 2002). The Jaguar has a muscular body, broad chest, and relatively shortlimbs, with the rounded head large compared to the rest of the body (Seymour 1989) (Figure 1). Moreover, it can be easily diagnosed from the only other large felid in the region, Puma (*Puma concolor* (Linnaeus, 1771)), which is smaller, with a relatively longer tail, and self-colored (Currier 1983).

Monte Alegre Farm (24°12′42″ S, 050°33′26″ W), owned by Klabin S.A., is a 269,700-ha sylvicultural farm located in the municipality of Telêmaco Borba, in central Paraná state. The local landscape forms a mosaic of native vegetation (110,000 ha) and silviculture (134,800 ha), with the latter divided among cultivated areas of *Eucalyptus* sp., *Pinus* sp., and *Araucaria angustifolia*. This forested area of the whole Monte Alegre Farm (Figure 2), although partially occupied by exotic species, represents an important remnant in Paraná, since it represents in terms of forest coverage in the state a relatively large portion of the preserved native vegetation, formed by an area of ecological tension between the Mixed Ombrophilous Forest and the Cerrado (Reis et al. 2006; IBGE 2012).

Inside the study area, medium-sized and large mammals have been monitored since 2011, through campaigns held twice yearly. The plantation matrix and four main fragments with native forest were monitored, with two areas sampled per campaign (the average size of the fragments is 1,580.4 ha). In each campaign, a total of 18 camera traps were used, nine in each fragment, and programmed to operate uninterruptedly for five days. This resulted in a sampling effort of 2,160 hours per campaign, totaling 12,960 hours throughout the six years monitored.

Monitoring was conducted through the use of camera traps, one of the most commonly used methods for sampling medium-sized and large mammals (Lyra-Jorge et al. 2014)

In 2016, with the use of camera traps, one adult Jaguar (unidentified sex) was recorded (Figure 1) moving along a road that crosses a field of *Eucalyptus* sp. Here, one side of the road had recent been harvested of *Eucalyptus* and was clear; the areas adjacent were fragments of native vegetation and fields of *Pinus* sp. This sighting is located 125 km west of the nearest record, a documented sighting in 1994 in the municipality of Palmeira (Medellin et al. 2001) (Figure 3). Until now, the Jaguar was thought to be probably extirpated from Monte Alegre Farm because no reliable documented sightings had been obtained for over 50 years (Reis et al. 2006).

Among the factors that explain the persistence of wild mammals in modified landscapes, the quality and permeability of the surrounding matrix is considered to be one of the most important (Umetsu et al. 2008; Santos-Filho et al. 2012). Compared with other land uses, such as extensive agricultural activities, silviculture may have less impact on local wildlife. The vertical structure in areas of silviculture resembles natural vegetation and there is a possibility that the understory has native vegetation (Coelho et al. 2014). Together, these become a determining matrix for the success of viable populations in areas under anthropic pressures (Boyle & Smith 2010).

In addition to the characteristics of the matrix, the presence or absence of species relies on the availability of resources (Trainor et al. 2014). In the study area, there several potential prey species for the Jaguar (Garla et al. 2001; Cullen Jr et al. 2013). Collared Peccary (*Pecari tajacu*),

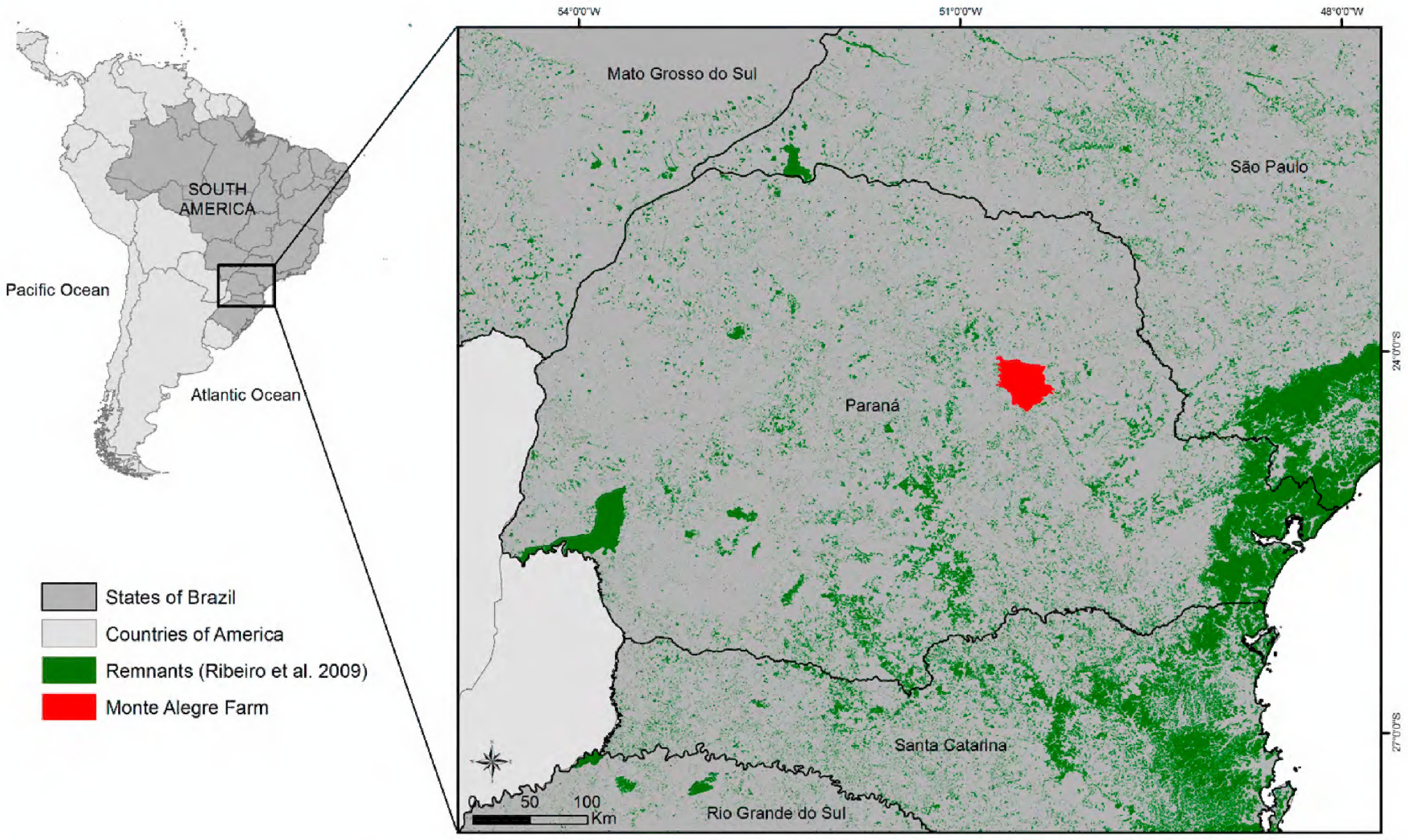

Figure 2. Location of Monte Alegre Farm (study area) in Parana state, Brazil, and Atlantic Forest remnants in the region (RIBEIRO et al. 2009).

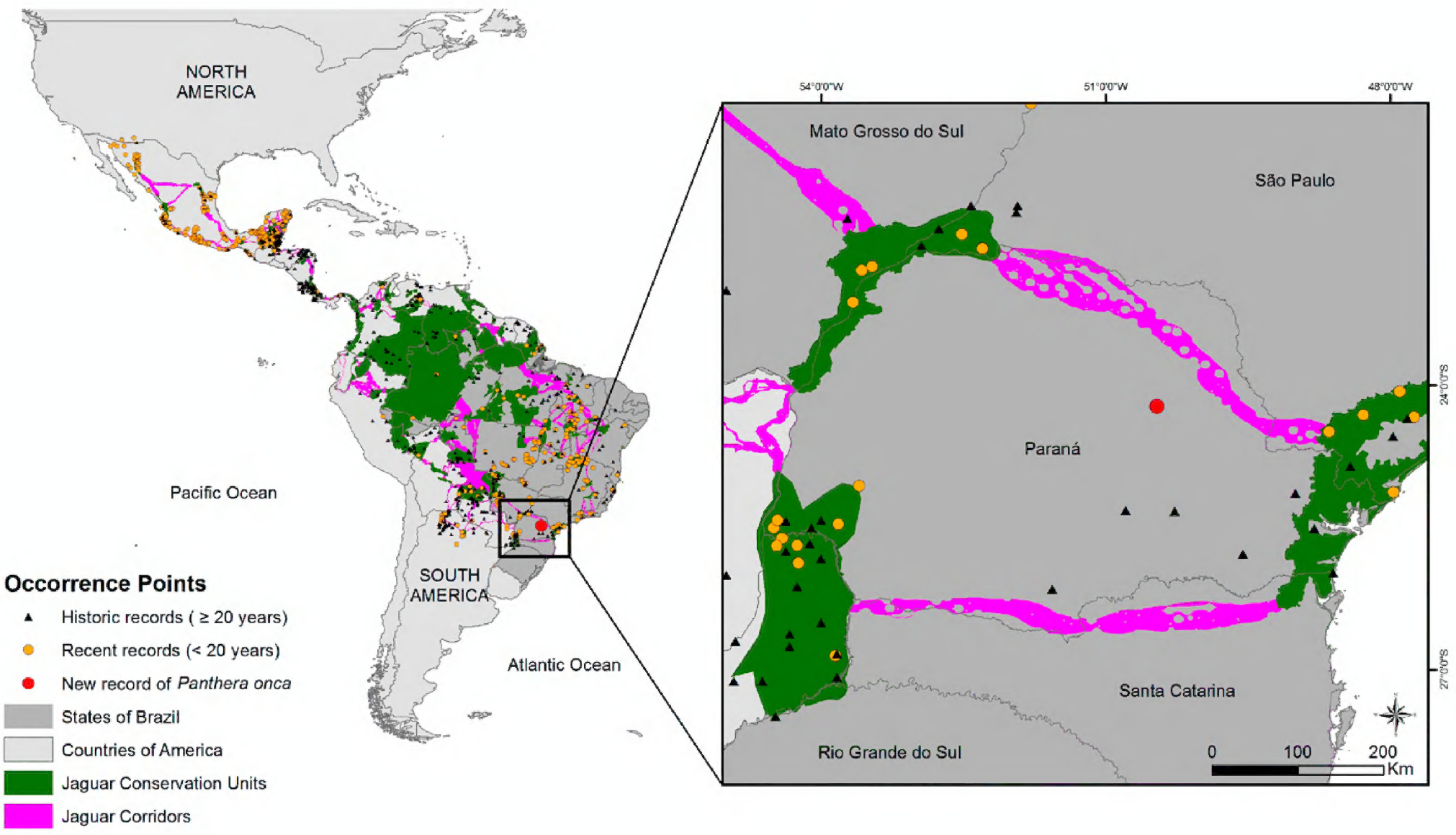

Figure 3. Map of the records of the jaguar *Panthera onca*, indicating priority areas for connectivity between the subpopulations of the species (pink) (Figure reproduced with authorization from PANTHERA 2016). Records according to MARES et al. (1981), EISENBERG (1989), REDFORD & EISENBERG (1992), CALOURO (1999), EISENBERG & REDFORD (1999), ORTEGA-HUERTA et al. (1999), NUÑES et al. (2000), GARLA et al. (2001), MEDELLIN et al. (2001), RODRIGUES et al. (2002), POLISAR et al. (2003), SCOGNAMILLO et al. (2003), MAFFEI et al. (2004), SILVER et al. (2004), DURDEN et al. (2006), HAAG et al. (2010), MORAES (2012), LIMA et al. (2013), and PAVIOLO et al. (2016).

White-lipped Peccary (*Tayassu pecari*), several armadillos (*Cabassous tatouay*, *Dasypus* spp., *Euphractus sexcinctus*), Coati (*Nasua nasua*), and Crab-eating Raccoon (*Procyon cancrivorus*) have been documented (Reis et al. 2006).

Among all recent records of the Jaguar in Paraná, this study is the first to report this species in a locality without a known subpopulation. It is believed that the observed individual belongs to the Serra do Mar subpopulation, given the proximity of this record to others in eastern Paraná, and is using the farm as a corridor. There is not much information about the current situation of the species in the coastal region of the Atlantic Forest in Parana state (Beisiegel et al. 2012). A third of all scientific production on the ecology of the Jaguar in Brazil is concentrated in the Pantanal region (Cavalcanti et al. 2010; Sollmann 2010).

Additionally, Monte Alegre Farm is located near an area identified by Rabinowitz et al. (pers. comm.) as important for the connectivity between remnant subpopulations of the Jaguar (Figure 3). The new record from Monte Alegre Farm suggests that silviculture matrices are permeable for large carnivores (Campos 2009; Lyra-Jorge et al. 2011) and corroborates the findings by Lima et al. (2013) in Mato Grosso do Sul state. Consequently, future studies are needed on the Jaguar in Paraná, as well as the permeability of the silviculture matrix, because the Monte Alegre Farm sighting was from outside the area thought by Paviolo et al. (2016) as being potentially occupied in the present day.

The native vegetation of Paraná has suffered greatly and is now highly fragmented and/or modified. Native vegetation currently covers 3.7 million ha, which represents only 18.51% of the original area (Accioly 2013). The establishment of ecological corridors in Paraná is needed for Jaguar conservation. Also needed is a better understanding of how land use and occupation influences the ecological dynamics of this species, and especially in terms of silviculture, which with 880,000 ha occupied (*Eucalyptus* and *Pinus* (IBA 2015) together represent 4.41% of the state's territory) is prevalent in Paraná.

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